File Copy

PATENT ABSTRACTS OF JAPAN

(11)Publication number : **07-022047**
(43)Date of publication of application : **24.01.1995**

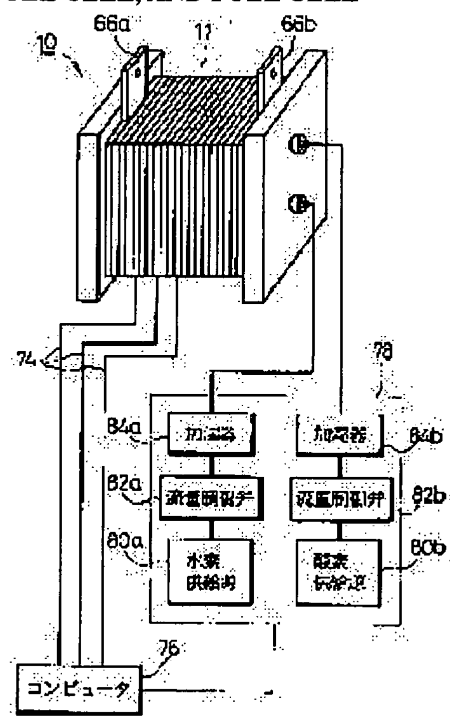
(51)Int.CI. H01M 8/04

(21)Application number : **05-159044**
(22)Date of filing : **29.06.1993**

(71)Applicant : **HONDA MOTOR CO LTD**
(72)Inventor : **BABA ICHIRO**
OKAMOTO TAKAFUMI
TANAKA MANABU
KATO HIDEO
KAWAGOE TAKAMASA

(54) **METHOD FOR CONTROLLING SOLID MACROMOLECULAR FUEL CELL, AND FUEL CELL**

(57)Abstract:
PURPOSE: To provide a method for controlling a solid macromolecular fuel cell, whereby a solid macromolecular electrolyte membrane and electrodes in the fuel cell are kept in proper conditions using simple constitution, and to provide the fuel cell.
CONSTITUTION: In a fuel cell 10 having a stack of unit cells 11, the unit cells 11 are provided with reference electrodes and the single-electrode potential of the anode and cathode of the unit cells 11 is calculated using a computer 76. The cause of the output degrading of the unit cells 11 is estimated according to changes in the single-electrode potential. Based on this estimate, control signals are output to flow control valves 82a, 82b or humidifiers 84a, 84b so as to adjust the flow rate of hydrogen or oxygen gas or the amount of humidification of the gas. The output of the unit cells 11 is therefore quickly restored.



LEGAL STATUS
[Date of request for examination] 28.06.2000
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] The control method of a solid-state macromolecule type fuel cell of supplying the 1st reagin and the 2nd reagin, respectively, and detecting the single electrode potential of an anode and a cathode using a reference electrode to the anode and cathode which are characterized by providing the following and which are joined to the both sides of an electrolyte film. Process in which the single electrode potential of the aforementioned anode and the aforementioned cathode is detected. Process in which the flow rate of process in which the situation inside a fuel cell is judged, the 1st reagin supplied to an anode and a cathode based on the aforementioned judgment, and the 2nd reagin, and the amount of humidification to the aforementioned reagin are adjusted based on the aforementioned single electrode potential.
[Claim 2] The fuel cell which supplies a reagin to an electrode from the reagin supply path characterized by providing the following. The anode and cathode which are joined to electrolytic both sides. the 1st reaction which is open for free passage to the aforementioned reagin supply path, and supplies the 1st reagin to an anode -- a member the 2nd reaction which is open for free passage to the aforementioned reagin supply path, and supplies the 2nd reagin to a cathode -- a member The reference electrode prepared between the free passage portions and anodes to the 1st reaction member of the aforementioned reagin supply path.

[Translation done.]

* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the fuel cell which equipped the detail with the mechanism in which the method for controlling suitably the humidity and temperature in a solid-state macromolecule type fuel cell and the single electrode potential of a unit cell are detectable, further about the control method of a solid-state macromolecule type fuel cell, and a fuel cell.
[0002]
[Description of the Prior Art] A solid-state macromolecule type fuel cell joins an electrode catalyst to the both sides of a solid-state polyelectrolyte film, and is constituted. A power generation operation is made to perform by the aforementioned fuel cell, when fuel gas and reactant gas, for example, oxygen and hydrogen, are supplied to the aforementioned electrode catalyst and a hydrogen ion moves in the inside of the aforementioned electrolyte film.
[0003] Although the amount of supply of the aforementioned gas is made increased in a place at the time of the rapid increase in a load, since the moisture of the aforementioned electrolyte film evaporates by this gas stream, there is a possibility of an electrolyte film drying by the increase in the calorific value accompanying a reaction, and reducing ion conductivity. Consequently, it becomes difficult to take out desired output voltage.
[0004] Then, the technical thought which establishes the water supply slot which pours the cooling water other than a gas supply slot in the gas separator which supplies gas to the aforementioned electrode is indicated by JP,3-102774,A as this cure. Therefore, although a steam is added in gas and the moisture to the aforementioned electrolyte film is usually sometimes supplied with the technical thought of this official report, while cooling an electrolyte film by supplying cooling water from the aforementioned water supply slot at the time of heavy load operation, moisture is supplied and the electrolyte film concerned is maintained to moderate humidity. Furthermore, it is supposed that it is automatically controllable by preparing the thermoregulator and flow control valve of a feedwater in the introductory pipe which is open for free passage into the aforementioned supply slot, and arranging a temperature sensor near an electrode or the solid-state polyelectrolyte film, and arranging a moisture sensor near the solid-state polyelectrolyte film, and controlling a thermoregulator and a flow control valve by the output signal of both sensors. Moreover, the technical thought which cools a fuel cell is also proposed by making it estrange from a fuel cell and preparing the member for cooling (JP,2-260371,A).
[0005] Since the aforementioned gas is not uniformly distributed over an electrode on the other hand when the moisture generated by the reaction of gas by the electrode condenses, the power generation force is spoiled.
[0006] The method of applying a hydrophilic paint film to the suitable position in a fuel cell, and promoting defluxion of generation water for example, in a U.S. Pat. No. 4,175,165 official report, as this cure, is indicated.
[0007]
[Problem(s) to be Solved by the Invention] However, in establishing a water supply slot in the aforementioned gas separator like aforementioned JP,3-102774,A, while the structure of a gas separator becomes complicated, there are problems, like there is the need of also increasing the path for supply of this water. Moreover, composition will be enlarged, when making the member for cooling estrange from a fuel cell and preparing it.
[0008] Furthermore, the state of a solid-state polyelectrolyte film is uncontrollable only by applying a hydrophilic paint film to the suitable place in a fuel cell so that it may be indicated by the aforementioned U.S. Pat. No. 4,175,165 official report, and flowing out generation water in the suitable state.
[0009] Moreover, even when a temperature sensor and a moisture sensor are attached and it performs automatic control, in order to detect where generation water is superfluous, you have to form a moisture sensor in two electrode catalysts which constitute at least one unit cell, respectively.
[0010] this invention is made in order to solve this kind of problem, is easy composition and aims at offering the control method of the solid-state macromolecule type fuel cell which can maintain the state of the solid-state polyelectrolyte film in a fuel cell, and an electrode in the suitable state, and a fuel cell.
[0011]
[Means for Solving the Problem] As opposed to the anode and cathode with which this invention is joined to the both sides of an electrolyte film in order to attain the aforementioned purpose Process in which are the control method of a solid-state macromolecule type fuel cell of supplying the 1st reagin and the 2nd reagin, respectively, and detecting the single electrode

potential of an anode and a cathode using a reference electrode, and the single electrode potential of the aforementioned anode and the aforementioned cathode is detected, It is characterized by having process in which the flow rate of process in which the situation inside a fuel cell is judged, the 1st reagin supplied to an anode and a cathode based on the aforementioned judgment, and the 2nd reagin, and the amount of humidification to the aforementioned reagin are adjusted, based on the aforementioned single electrode potential.

[0012] Moreover, this invention is set to the fuel cell which supplies a reagin to an electrode from a reagin supply path. The anode and cathode which are joined to electrolytic both sides, and the 1st reaction member which is open for free passage to the aforementioned reagin supply path, and supplies the 1st reagin to an anode, It is open for free passage to the aforementioned reagin supply path, and is characterized by having the reference electrode prepared between the free passage portions and anodes to the 2nd reaction member which supplies the 2nd reagin to a cathode, and the 1st reaction member of the aforementioned reagin supply path.

[0013]

[Function] By the control method of the solid-state macromolecule type fuel cell concerning this invention, the single electrode potential of an anode and a cathode is detected using a reference electrode, respectively, the situation inside a fuel cell is judged based on change of the aforementioned single electrode potential, and the flow rate of the 1st reagin supplied to an anode and a cathode and the 2nd reagin and the amount of humidification to the aforementioned reagin are adjusted. For example, if the single electrode potential of the anode of a fuel cell is rising when increasing the load of a fuel cell, or if the single electrode potential of a cathode is falling, it judges with generation water overflowing with the electrodes concerned, and while making the flow rate of the reagin supplied to the electrode concerned increase, the humidification to the aforementioned reagin will be stopped. On the other hand, if the single electrode potential of an anode rises and the single electrode potential of a cathode is falling, it will judge with generation water being full of two electrodes first, the humidification to the 1st and 2nd reagins will be stopped, and the flow rate of the above 1st and the 2nd reagin will be made to increase. If a situation still does not improve, it judges with the electrolyte film being dry, and the amount of humidification to the above 1st and the 2nd reagin is made to increase.

[0014] Moreover, by the fuel cell concerning this invention, since the reference electrode was prepared between the free passage portions and anodes to the 1st reaction member of a reagin supply path, the concentration of the 1st reagin which acts on a reference electrode becomes almost fixed, and the reference potential by which the reference electrode was stabilized is shown. Therefore, an anode and a cathode, and each single electrode potential are detectable with a sufficient precision.

[0015]

[Example] It explains to a detail below, giving a suitable example and referring to an attached drawing about the control method of a solid-state macromolecule type fuel cell and fuel cell concerning this invention.

[0016] First, composition is explained about a solid-state macromolecule type fuel cell, and the control method of the fuel cell is explained below.

[0017] The fuel cell 10 is constituted by carrying out two or more laminatings of the unit cell 11, as shown in drawing 1 . The aforementioned unit cell 11 consists of the power generation section 12 and an attaching part 14, as shown in drawing 2 and drawing 3 .

[0018] The aforementioned attaching part 14 comes to carry out the laminating of the 1st comparatively thick board 16 and the 2nd board 18. The rectangular parallelepiped-like breakthroughs 22, 24, 26, and 28 are formed by cope-box 16a of the 1st board 16 of the above, drag-flask 16b, and side frames 16c and 16d, respectively so that the osculum 20 of a **** square configuration may be formed by the center section of the 1st board 16 and this osculum 20 may be surrounded in it. In this case, a breakthrough 26 is open for free passage through an osculum 20 and two or more pores 30, and, on the other hand, the breakthrough 28 is opening it for free passage with the osculum 20 through two or more pores 32 similarly.

[0019] Next, the 2nd board 18 is explained. The same osculum 34 as the 1st board 16 is formed by the center section of the 2nd board 18, and the rectangular parallelepiped-like breakthroughs 36, 38, 40, and 42 are formed by cope-box 18a, drag-flask 18b, and side frames 18c and 18d, respectively so that the osculum 34 may be surrounded. In this 2nd board 18, the osculum 34 and the breakthrough 36 are opened for free passage by two or more pores 44, and, on the other hand, this osculum 34 and the breakthrough 38 are similarly opened for free passage by two or more pores 46.

[0020] Next, the power generation section 12 is explained.

[0021] Fundamentally, the power generation section 12 consists of electrode one apparatus electrolyte films 54 pinched between the charge collectors 50 and 52 of a lot, and the aforementioned charge collectors 50 and 52. Charge collectors 50 and 52 are formed as the rigid body made from carbon.

[0022] the aforementioned charge collector 50 fits into the osculum 20 of the 1st board 16 which constitutes an attaching part 14 with the crevice between some -- it should have -- a **** square configuration -- and the 1st board 16 of the above and abbreviation -- it consists of a board of the same thickness

[0023] As shown in the aforementioned charge collector 50 at drawing 2 and drawing 3 , in order are open for free passage with the pores 30 and 32 of the 1st board 16 of the above and to absorb reactant gas, two or more slots 56 are formed that a surface area should be expanded. Therefore, if the aforementioned charge collector 50 fits into the osculum 20 of the 1st board 16, a slot 56 will be open for free passage with breakthroughs 26 and 28 through pores 30 and 32, respectively.

[0024] the **** square configuration corresponding to the osculum 34 of the 2nd board 18 in a charge collector 52 -- the 2nd board 18 of a parenthesis, and abbreviation -- it consists of a board of the same thickness Two or more slots 58 which are open for free passage to the pores 44 and 46 currently formed by this 2nd board 18 are formed by the aforementioned charge collector

52. Therefore, if the aforementioned charge collector 52 fits into the osculum 34 of the 2nd board 18, a slot 58 will be open for free passage with breakthroughs 36 and 38 through pores 44 and 46, respectively.

[0025] The aforementioned electrode one apparatus electrolyte film 54 equips both sides of the solid-state polyelectrolyte film 60 with the electrode catalyst beds 62a and 62b. if the aforementioned solid-state polyelectrolyte film 60 is explained in relation to the 1st board 16 -- the size -- the inside edge of breakthroughs 22, 24, 26, and 28, and abbreviation -- the same -- on the other hand -- the size of the electrode catalyst beds 62a and 62b -- charge collectors 50 and 52 and abbreviation -- it is the same

[0026] In addition, the gasket 64 is infixed between the 1st board 16 of the above, and the 2nd board 18.

[0027] Thus, the fuel cell 10 is constituted by carrying out two or more laminatings of the constituted unit cell 11. The output from the aforementioned fuel cell 10 is drawn from output terminals 66a and 66b (refer to drawing 1). Moreover, between the adjoining unit cells 11, the gasket 68 with which the pore corresponding to the breakthrough portions of the 1st board 16 of the above and the 2nd board 18 was formed is pinched. In addition, when the laminating of the unit cell 11 is carried out, breakthroughs 22 and 36 consider as an oxygen gas supply path, as an oxygen gas eccrisis path, breakthroughs 26 and 40 are used as a hydrogen gas supply path, and breakthroughs 28 and 42 are used for breakthroughs 24 and 38 as a hydrogen gas eccrisis path.

[0028] In the aforementioned fuel cell 10, as some unit cells 11 are shown in drawing 4 , the reference electrode 70 which becomes the pore 30 of the 1st board 16 from a gas diffusion electrode is formed, and the signal is outputted to the computer 76 through lead wire 74 with the electrode catalyst beds 62a and 62b.

[0029] The aforementioned computer 76 supplies a control signal to the gas supply unit 78, as shown in drawing 1 . The aforementioned gas supply unit 78 is equipped with hydrogen source-of-supply 80a and oxygen-supply 80b, respectively, and is equipped with the flow control valves 82a and 82b which control a flow rate by the aforementioned control signal, and the humidifiers 84a and 84b to which temperature is changed into and the amount of humidification is changed with the aforementioned control signal.

[0030] Next, the control method of the fuel cell 10 constituted in this way is explained hereafter.

[0031] First, based on the control signal from a computer 76, the flow rate of hydrogen source-of-supply 80a, the oxygen gas supplied from oxygen-supply 80b, and hydrogen gas is controlled by flow control valves 82a and 82b to the specified quantity, respectively, and the steam of the specified quantity is further added and humidified to the aforementioned oxygen gas and hydrogen gas by controlling Humidifiers 84a and 84b to predetermined temperature.

[0032] Thus, a flow rate is regulated by the specified quantity and the oxygen gas and hydrogen gas by which specified quantity humidification was carried out are introduced into the interior of a fuel cell 10. In a fuel cell 10, hydrogen gas reaches the breakthrough 26 which is the hydrogen gas supply path of the 1st board 16 of each unit cell 11, and is supplied to the slot 56 of a charge collector 50 through pore 30. Hydrogen gas reaches electrode catalyst bed 62a from the aforementioned charge collector 50. Oxygen gas reaches the breakthrough 36 which is the oxygen supply path of the 2nd board 18 of each unit cell 11, and is supplied to the slot 58 of a charge collector 52 from pore 44. The aforementioned oxygen gas reaches electrode catalyst bed 62b from the aforementioned charge collector 52. Therefore, a hydrogen ion moves in the inside of the solid-state polyelectrolyte film 60, and total of the output of each unit cell 11 is taken out from output terminals 66a and 66b.

[0033] Under the present circumstances, the output signal from a reference electrode 70 and the electrode catalyst beds 62a and 62b is introduced into a computer 76 through lead wire 74. By computer 76, the single electrode potential of electrode catalyst bed (henceforth anode) 62a to which hydrogen gas is supplied is detected based on the output signal of the aforementioned reference electrode 70 and electrode catalyst bed 62a. Similarly, based on the output signal of the aforementioned reference electrode 70 and electrode catalyst bed 62b, the single electrode potential of electrode catalyst bed (henceforth cathode) 62b to which oxygen gas is supplied is detected. Under the present circumstances, only the hydrogen gas supplied to anode 62a since the reference electrode 70 is formed in pore 30 passes the aforementioned reference electrode 70, and since composition of the gas to pass does not change, the reference potential is outputted stably. Therefore, the single electrode potential of anode 62a and cathode 62b is detectable with a sufficient precision.

[0034] Here, the relation between current density, the aforementioned anode 62a, and the single electrode potential of cathode 62b is shown in drawing 5 - drawing 8 . Drawing 5 is drawing showing the relation between the current density of a normal state, and single electrode potential. In addition, when the single electrode potential of anode 62a of two or more unit cells 11 and cathode 62b is detected, the inside of anode 62a, cathode 62b, the average of the single electrode potential value of plurality respectively, maximum, or the minimum value and one of values is calculated by computer 76, and the calculated value performs the following control.

[0035] At the time of load increase of a fuel cell 10, the single electrode potential of anode 62a as shown in drawing 6 , and cathode 62b may be detected. That is, only the single electrode potential of anode 62a rises sharply, and is reducing the output voltage of the unit cell 11. In this case, by computer 76, the distance/velocity lag of the matter in anode 62a judges with a cause. That is, since the generation water by the reaction of oxygen gas and hydrogen gas piles up in anode 62a and obstructs that hydrogen gas moves, it judges with the single electrode potential of anode 62a having risen sharply. Therefore, while the signal which makes a hydrogen gas flow rate increase from a computer 76 to flow-control-valve 82a is outputted, the signal which stops humidification is outputted to humidifier 84a. Consequently, while the moisture of anode 62a evaporates by the aforementioned hydrogen gas style, in order to stop the humidification to the aforementioned hydrogen gas, the moisture which is piling up in anode 62a is removed. Therefore, the single electrode potential of anode 62a falls, and it recovers to predetermined output voltage.

[0036] As shown in drawing 7 , when similarly the single electrode potential of cathode 62b falls sharply, the distance/velocity lag of the matter [in / cathode 62b / in a computer 76] judges with a cause. That is, it judges with generation water piling up in cathode 62b. Therefore, while the control signal which makes the amount of oxygen gas increase from a computer 76 to flow-control-valve 82b is outputted, the control signal which makes humidifier 84b stop the humidification to oxygen gas is outputted. Thereby, single electrode potential rises to cathode 62b, and the output voltage of the unit cell 11 is recovered.
[0037] Furthermore, as shown in drawing 8 , when the single electrode potential of anode 62a, cathode 62b, and both sides falls sharply, possibility that generation water piled up in the both sides of anode 62a and cathode 62b as mentioned above is considered, and the moisture of the solid-state polyelectrolyte film 60 decreases by the gas stream of generation of heat by power generation operation, hydrogen, or oxygen, and possibility that ion conductivity fell is also considered.
[0038] Then, by computer 76, like the case of drawing 6 and drawing 7 , the flow rate of hydrogen gas and oxygen gas is made to increase, and the humidification to the aforementioned gas is stopped first. Consequently, the single electrode potential of anode 62a falls, and this state will be made to continue, if the single electrode potential of cathode 62b rises and output voltage is recovered.
[0039] However, when the single electrode potential of the aforementioned anode 62a and cathode 62b is not recovered, the amount of humidification to hydrogen gas and oxygen gas is increased by judging with dryness of the solid-state polyelectrolyte film 60 being the cause, outputting a control signal to Humidifiers 84a and 84b, and raising the temperature of the humidifiers 84a and 84b concerned. Consequently, moisture is fully supplied to the solid-state polyelectrolyte film 60, and ion conductivity is recovered. Therefore, the single electrode potential of anode 62a falls, the single electrode potential of cathode 62b rises, and the output voltage of the unit cell 11 is recovered.
[0040] Thus, in the fuel cell 10 concerning this example, since the reference electrode 70 was formed in pore 30 and it outputted to the computer 76 with the output signal of anode 62a and cathode 62b, the single electrode potential of anode 62a and cathode 62b was called for by computer 76. Based on change of this single electrode potential, causes, such as stay of generation water to aforementioned anode 62a or cathode 62b and dryness of the solid-state polyelectrolyte film 60, are judged, based on the aforementioned judgment, the flow rate of hydrogen gas and oxygen gas can be controlled, or the output voltage of a unit cell can be maintained to a steady state by controlling the amount of humidification to the aforementioned gas.
[0041] Moreover, since the reference electrode 70 was formed in the pore 30 which is open for free passage from a breakthrough 26 to a charge collector 50, composition of hydrogen gas cannot change to it and a reference potential can be stably detected to it.
[0042] In addition, although a reference electrode is prepared in one or more unit cells, the single electrode potential of anode 62a and cathode 62b is detected and the quantity of gas flow to all the unit cells 11 and the amount of humidification to the gas concerned are identically controlled by this example based on the aforementioned detection value, it is still more suitable if the flow control valve and humidifier of gas which are supplied to each unit cell are formed while preparing a reference electrode in all unit cells. Namely, based on the single electrode potential of each unit cell, the flow rate of the gas to each unit cell and the amount of humidification to gas can be controlled by each unit cell, and minute control is attained for every unit cell by it.
[0043]
[Effect of the Invention] According to the control method of a solid-state macromolecule type fuel cell and fuel cell concerning this invention, the following effects are acquired.
[0044] That is, by the control method of the solid-state macromolecule type fuel cell concerning this invention, the single electrode potential of an anode and a cathode is detected using a reference electrode, respectively, the situation inside a fuel cell is judged based on change of the aforementioned single electrode potential, and the flow rate of the 1st reagin supplied to an anode and a cathode and the 2nd reagin and the amount of humidification to the aforementioned reagin are adjusted. For example, if the single electrode potential of an anode is rising when increasing the load of a fuel cell, or if the single electrode potential of a cathode is falling, it judges with generation water overflowing with the electrodes concerned, and while making the flow rate of the reagin supplied to the electrode concerned increase, the humidification to the aforementioned reagin will be stopped. On the other hand, if the single electrode potential of an anode rises and the single electrode potential of a cathode is falling, it will judge with generation water being full of two electrodes first, the humidification to the 1st and 2nd reagins will be stopped, and a flow rate will be made to increase. If a situation still does not improve, it judges with the electrolyte film being dry, and the amount of humidification to the above 1st and the 2nd reagin is made to increase. Thus, the situation inside a unit cell can be judged based on the single electrode potential of a unit cell, and the flow rate of a reagin and the amount of humidification to a reagin can be adjusted quickly.
[0045] Moreover, by the fuel cell concerning this invention, since the reference electrode was prepared between the free passage portions and anodes to the 1st reaction member of a reagin supply path, the concentration of the 1st reagin which acts on a reference electrode becomes almost fixed, and the reference potential by which the reference electrode was stabilized is shown. Therefore, an anode and a cathode, and each single electrode potential are detectable with a sufficient precision.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] this invention relates to the fuel cell which equipped the detail with the mechanism in which the method for controlling suitably the humidity and temperature in a solid-state macromolecule type fuel cell and the single electrode potential of a unit cell are detectable, further about the control method of a solid-state macromolecule type fuel cell, and a fuel cell.

[Translation done.]

PRIOR ART

[Description of the Prior Art] A solid-state macromolecule type fuel cell joins an electrode catalyst to the both sides of a solid-state polyelectrolyte film, and is constituted. A power generation operation is made to perform by the aforementioned fuel cell, when fuel gas and reactant gas, for example, oxygen and hydrogen, are supplied to the aforementioned electrode catalyst and a hydrogen ion moves in the inside of the aforementioned electrolyte film.
[0003] Although the amount of supply of the aforementioned gas is made increased in a place at the time of the rapid increase in a load, since the moisture of the aforementioned electrolyte film evaporates by this gas stream, there is a possibility of an electrolyte film drying by the increase in the calorific value accompanying a reaction, and reducing ion conductivity. Consequently, it becomes difficult to take out desired output voltage.
[0004] Then, the technical thought which establishes the water supply slot which pours the cooling water other than a gas supply slot in the gas separator which supplies gas to the aforementioned electrode is indicated by JP,3-102774,A as this cure. Therefore, although a steam is added in gas and the moisture to the aforementioned electrolyte film is usually sometimes supplied with the technical thought of this official report, while cooling an electrolyte film by supplying cooling water from the aforementioned water supply slot at the time of heavy load operation, moisture is supplied and the electrolyte film concerned is maintained to moderate humidity. Furthermore, it is supposed that it is automatically controllable by preparing the thermoregulator and flow control valve of a feedwater in the introductory pipe which is open for free passage into the aforementioned supply slot, and arranging a temperature sensor near an electrode or the solid-state polyelectrolyte film, and arranging a moisture sensor near the solid-state polyelectrolyte film, and controlling a thermoregulator and a flow control valve by the output signal of both sensors. Moreover, the technical thought which cools a fuel cell is also proposed by making it estrange from a fuel cell and preparing the member for cooling (JP,2-260371,A).
[0005] Since the aforementioned gas is not uniformly distributed over an electrode on the other hand when the moisture generated by the reaction of gas by the electrode condenses, the power generation force is spoiled.
[0006] The method of applying a hydrophilic paint film to the suitable position in a fuel cell, and promoting defluxion of generation water for example, in a U.S. Pat. No. 4,175,165 official report, as this cure, is indicated.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to the control method of a solid-state macromolecule type fuel cell and fuel cell concerning this invention, the following effects are acquired.

[0044] That is, by the control method of the solid-state macromolecule type fuel cell concerning this invention, the single electrode potential of an anode and a cathode is detected using a reference electrode, respectively, the situation inside a fuel cell is judged based on change of the aforementioned single electrode potential, and the flow rate of the 1st reagin supplied to an anode and a cathode and the 2nd reagin and the amount of humidification to the aforementioned reagin are adjusted. For example, if the single electrode potential of an anode is rising when increasing the load of a fuel cell, or if the single electrode potential of a cathode is falling, it judges with generation water overflowing with the electrodes concerned, and while making the flow rate of the reagin supplied to the electrode concerned increase, the humidification to the aforementioned reagin will be stopped. On the other hand, if the single electrode potential of an anode rises and the single electrode potential of a cathode is falling, it will judge with generation water being full of two electrodes first, the humidification to the 1st and 2nd reagins will be stopped, and a flow rate will be made to increase. If a situation still does not improve, it judges with the electrolyte film being dry, and the amount of humidification to the above 1st and the 2nd reagin is made to increase. Thus, the situation inside a unit cell can be judged based on the single electrode potential of a unit cell, and the flow rate of a reagin and the amount of humidification to a reagin can be adjusted quickly.

[0045] Moreover, by the fuel cell concerning this invention, since the reference electrode was prepared between the free passage portions and anodes to the 1st reaction member of a reagin supply path, the concentration of the 1st reagin which acts on a reference electrode becomes almost fixed, and the reference potential by which the reference electrode was stabilized is shown. Therefore, an anode and a cathode, and each single electrode potential are detectable with a sufficient precision.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in establishing a water supply slot in the aforementioned gas separator like aforementioned JP,3-102774,A, while the structure of a gas separator becomes complicated, there are problems, like there is the need of also increasing the path for supply of this water. Moreover, composition will be enlarged, when making the member for cooling estrange from a fuel cell and preparing it.
[0008] Furthermore, the state of a solid-state polyelectrolyte film is uncontrollable only by applying a hydrophilic paint film to the suitable place in a fuel cell so that it may be indicated by the aforementioned U.S. Pat. No. 4,175,165 official report, and flowing out generation water in the suitable state.
[0009] Moreover, even when a temperature sensor and a moisture sensor are attached and it performs automatic control, in order to detect where generation water is superfluous, you have to form a moisture sensor in two electrode catalysts which constitute at least one unit cell, respectively.
[0010] this invention is made in order to solve this kind of problem, is easy composition and aims at offering the control method of the solid-state macromolecule type fuel cell which can maintain the state of the solid-state polyelectrolyte film in a fuel cell, and an electrode in the suitable state, and a fuel cell.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the aforementioned purpose, it is characterized by equipping this invention with the following. Process in which are the control method of a solid-state macromolecule type fuel cell of supplying the 1st reagin and the 2nd reagin, respectively, and detecting the single electrode potential of an anode and a cathode to the anode and cathode which are joined to the both sides of an electrolyte film using a reference electrode, and the single electrode potential of the aforementioned anode and the aforementioned cathode is detected. Process in which the situation inside a fuel cell is judged based on the aforementioned single electrode potential. Process in which the flow rate of the 1st reagin supplied to an anode and a cathode based on the aforementioned judgment and the 2nd reagin and the amount of humidification to the aforementioned reagin are adjusted.
[0012] Moreover, this invention is characterized by equipping with the following the fuel cell which supplies a reagin to an electrode from a reagin supply path. The anode and cathode which are joined to electrolytic both sides. the 1st reaction which is open for free passage to the aforementioned reagin supply path, and supplies the 1st reagin to an anode -- a member The reference electrode prepared between the free passage portions and anodes to the 2nd reaction member which is open for free passage to the aforementioned reagin supply path, and supplies the 2nd reagin to a cathode, and the 1st reaction member of the aforementioned reagin supply path.

[Translation done.]

OPERATION

[Function] By the control method of the solid-state macromolecule type fuel cell concerning this invention, the single electrode potential of an anode and a cathode is detected using a reference electrode, respectively, the situation inside a fuel cell is judged based on change of the aforementioned single electrode potential, and the flow rate of the 1st reagin supplied to an anode and a cathode and the 2nd reagin and the amount of humidification to the aforementioned reagin are adjusted. For example, if the single electrode potential of the anode of a fuel cell is rising when increasing the load of a fuel cell, or if the single electrode potential of a cathode is falling, it judges with generation water overflowing with the electrodes concerned, and while making the flow rate of the reagin supplied to the electrode concerned increase, the humidification to the aforementioned reagin will be stopped. On the other hand, if the single electrode potential of an anode rises and the single electrode potential of a cathode is falling, it will judge with generation water being full of two electrodes first, the humidification to the 1st and 2nd reagins will be stopped, and the flow rate of the above 1st and the 2nd reagin will be made to increase. If a situation still does not improve, it judges with the electrolyte film being dry, and the amount of humidification to the above 1st and the 2nd reagin is made to increase.
[0014] Moreover, by the fuel cell concerning this invention, since the reference electrode was prepared between the free passage portions and anodes to the 1st reaction member of a reagin supply path, the concentration of the 1st reagin which acts on a reference electrode becomes almost fixed, and the reference potential by which the reference electrode was stabilized is shown. Therefore, an anode and a cathode, and each single electrode potential are detectable with a sufficient precision.

[Translation done.]

EXAMPLE

[Example] It explains to a detail below, giving a suitable example and referring to an attached drawing about the control method of a solid-state macromolecule type fuel cell and fuel cell concerning this invention.
[0016] First, composition is explained about a solid-state macromolecule type fuel cell, and the control method of the fuel cell is explained below.
[0017] The fuel cell 10 is constituted by carrying out two or more laminatings of the unit cell 11, as shown in drawing 1 . The aforementioned unit cell 11 consists of the power generation section 12 and an attaching part 14, as shown in drawing 2 and drawing 3 .
[0018] The aforementioned attaching part 14 comes to carry out the laminating of the 1st comparatively thick board 16 and the 2nd board 18. The rectangular parallelepiped-like breakthroughs 22, 24, 26, and 28 are formed by cope-box 16a of the 1st board 16 of the above, drag-flask 16b, and side frames 16c and 16d, respectively so that the osculum 20 of a **** square configuration may be formed by the center section of the 1st board 16 and this osculum 20 may be surrounded in it. In this case, a breakthrough 26 is open for free passage through an osculum 20 and two or more pores 30, and, on the other hand, the breakthrough 28 is opening it for free passage with the osculum 20 through two or more pores 32 similarly.
[0019] Next, the 2nd board 18 is explained. The same osculum 34 as the 1st board 16 is formed by the center section of the 2nd board 18, and the rectangular parallelepiped-like breakthroughs 36, 38, 40, and 42 are formed by cope-box 18a, drag-flask 18b, and side frames 18c and 18d, respectively so that the osculum 34 may be surrounded. In this 2nd board 18, the osculum 34 and the breakthrough 36 are opened for free passage by two or more pores 44, and, on the other hand, this osculum 34 and the breakthrough 38 are similarly opened for free passage by two or more pores 46.
[0020] Next, the power generation section 12 is explained.
[0021] Fundamentally, the power generation section 12 consists of electrode one apparatus electrolyte films 54 pinched between the charge collectors 50 and 52 of a lot, and the aforementioned charge collectors 50 and 52. Charge collectors 50 and 52 are formed as the rigid body made from carbon.
[0022] the aforementioned charge collector 50 fits into the osculum 20 of the 1st board 16 which constitutes an attaching part 14 with the crevice between some -- it should have -- a **** square configuration -- and the 1st board 16 of the above and abbreviation -- it consists of a board of the same thickness
[0023] As shown in the aforementioned charge collector 50 at drawing 2 and drawing 3 , in order are open for free passage with the pores 30 and 32 of the 1st board 16 of the above and to absorb reactant gas, two or more slots 56 are formed that a surface area should be expanded. Therefore, if the aforementioned charge collector 50 fits into the osculum 20 of the 1st board 16, a slot 56 will be open for free passage with breakthroughs 26 and 28 through pores 30 and 32, respectively.
[0024] the **** square configuration corresponding to the osculum 34 of the 2nd board 18 in a charge collector 52 -- the 2nd board 18 of a parenthesis, and abbreviation -- it consists of a board of the same thickness Two or more slots 58 which are open for free passage to the pores 44 and 46 currently formed by this 2nd board 18 are formed by the aforementioned charge collector 52. Therefore, if the aforementioned charge collector 52 fits into the osculum 34 of the 2nd board 18, a slot 58 will be open for free passage with breakthroughs 36 and 38 through pores 44 and 46, respectively.
[0025] The aforementioned electrode one apparatus electrolyte film 54 equips both sides of the solid-state polyelectrolyte film 60 with the electrode catalyst beds 62a and 62b. if the aforementioned solid-state polyelectrolyte film 60 is explained in relation to the 1st board 16 -- the size -- the inside edge of breakthroughs 22, 24, 26, and 28, and abbreviation -- the same -- on the other hand -- the size of the electrode catalyst beds 62a and 62b -- charge collectors 50 and 52 and abbreviation -- it is the same
[0026] In addition, the gasket 64 is infixed between the 1st board 16 of the above, and the 2nd board 18.
[0027] Thus, the fuel cell 10 is constituted by carrying out two or more laminatings of the constituted unit cell 11. The output from the aforementioned fuel cell 10 is drawn from output terminals 66a and 66b (refer to drawing 1). Moreover, between the adjoining unit cells 11, the gasket 68 with which the pore corresponding to the breakthrough portions of the 1st board 16 of the above and the 2nd board 18 was formed is pinched. In addition, when the laminating of the unit cell 11 is carried out, breakthroughs 22 and 36 consider as an oxygen gas supply path, as an oxygen gas eccrisis path, breakthroughs 26 and 40 are used as a hydrogen gas supply path, and breakthroughs 28 and 42 are used for breakthroughs 24 and 38 as a hydrogen gas eccrisis path.
[0028] In the aforementioned fuel cell 10, as some unit cells 11 are shown in drawing 4 , the reference electrode 70 which becomes the pore 30 of the 1st board 16 from a gas diffusion electrode is formed, and the signal is outputted to the computer 76

through lead wire 74 with the electrode catalyst beds 62a and 62b.
[0029] The aforementioned computer 76 supplies a control signal to the gas supply unit 78, as shown in drawing 1 . The aforementioned gas supply unit 78 is equipped with hydrogen source-of-supply 80a and oxygen-supply 80b, respectively, and is equipped with the flow control valves 82a and 82b which control a flow rate by the aforementioned control signal, and the humidifiers 84a and 84b to which temperature is changed into and the amount of humidification is changed with the aforementioned control signal.
[0030] Next, the control method of the fuel cell 10 constituted in this way is explained hereafter.
[0031] First, based on the control signal from a computer 76, the flow rate of hydrogen source-of-supply 80a, the oxygen gas supplied from oxygen-supply 80b, and hydrogen gas is controlled by flow control valves 82a and 82b to the specified quantity, respectively, and the steam of the specified quantity is further added and humidified to the aforementioned oxygen gas and hydrogen gas by controlling Humidifiers 84a and 84b to predetermined temperature.
[0032] Thus, a flow rate is regulated by the specified quantity and the oxygen gas and hydrogen gas by which specified quantity humidification was carried out are introduced into the interior of a fuel cell 10. In a fuel cell 10, hydrogen gas reaches the breakthrough 26 which is the hydrogen gas supply path of the 1st board 16 of each unit cell 11, and is supplied to the slot 56 of a charge collector 50 through pore 30. Hydrogen gas reaches electrode catalyst bed 62a from the aforementioned charge collector 50. Oxygen gas reaches the breakthrough 36 which is the oxygen supply path of the 2nd board 18 of each unit cell 11, and is supplied to the slot 58 of a charge collector 52 from pore 44. The aforementioned oxygen gas reaches electrode catalyst bed 62b from the aforementioned charge collector 52. Therefore, a hydrogen ion moves in the inside of the solid-state polyelectrolyte film 60, and total of the output of each unit cell 11 is taken out from output terminals 66a and 66b.
[0033] Under the present circumstances, the output signal from a reference electrode 70 and the electrode catalyst beds 62a and 62b is introduced into a computer 76 through lead wire 74. By computer 76, the single electrode potential of electrode catalyst bed (henceforth anode) 62a to which hydrogen gas is supplied is detected based on the output signal of the aforementioned reference electrode 70 and electrode catalyst bed 62a. Similarly, based on the output signal of the aforementioned reference electrode 70 and electrode catalyst bed 62b, the single electrode potential of electrode catalyst bed (henceforth cathode) 62b to which oxygen gas is supplied is detected. Under the present circumstances, only the hydrogen gas supplied to anode 62a since the reference electrode 70 is formed in pore 30 passes the aforementioned reference electrode 70, and since composition of the gas to pass does not change, the reference potential is outputted stably. Therefore, the single electrode potential of anode 62a and cathode 62b is detectable with a sufficient precision.
[0034] Here, the relation between current density, the aforementioned anode 62a, and the single electrode potential of cathode 62b is shown in drawing 5 - drawing 8 . Drawing 5 is drawing showing the relation between the current density of a normal state, and single electrode potential. In addition, when the single electrode potential of anode 62a of two or more unit cells 11 and cathode 62b is detected, the inside of anode 62a, cathode 62b, the average of the single electrode potential value of plurality respectively, maximum, or the minimum value and one of values is calculated by computer 76, and the calculated value performs the following control.
[0035] At the time of load increase of a fuel cell 10, the single electrode potential of anode 62a as shown in drawing 6 , and cathode 62b may be detected. That is, only the single electrode potential of anode 62a rises sharply, and is reducing the output voltage of the unit cell 11. In this case, by computer 76, the distance/velocity lag of the matter in anode 62a judges with a cause. That is, since the generation water by the reaction of oxygen gas and hydrogen gas piles up in anode 62a and obstructs that hydrogen gas moves, it judges with the single electrode potential of anode 62a having risen sharply. Therefore, while the signal which makes a hydrogen gas flow rate increase from a computer 76 to flow-control-valve 82a is outputted, the signal which stops humidification is outputted to humidifier 84a. Consequently, while the moisture of anode 62a evaporates by the aforementioned hydrogen gas style, in order to stop the humidification to the aforementioned hydrogen gas, the moisture which is piling up in anode 62a is removed. Therefore, the single electrode potential of anode 62a falls, and it recovers to predetermined output voltage.
[0036] As shown in drawing 7 , when similarly the single electrode potential of cathode 62b falls sharply, the distance/velocity lag of the matter [in / cathode 62b / in a computer 76] judges with a cause. That is, it judges with generation water piling up in cathode 62b. Therefore, while the control signal which makes the amount of oxygen gas increase from a computer 76 to flow-control-valve 82b is outputted, the control signal which makes humidifier 84b stop the humidification to oxygen gas is outputted. Thereby, single electrode potential rises to cathode 62b, and the output voltage of the unit cell 11 is recovered.
[0037] Furthermore, as shown in drawing 8 , when the single electrode potential of anode 62a, cathode 62b, and both sides falls sharply, possibility that generation water piled up in the both sides of anode 62a and cathode 62b as mentioned above is considered, and the moisture of the solid-state polyelectrolyte film 60 decreases by the gas stream of generation of heat by power generation operation, hydrogen, or oxygen, and possibility that ion conductivity fell is also considered.
[0038] Then, by computer 76, like the case of drawing 6 and drawing 7 , the flow rate of hydrogen gas and oxygen gas is made to increase, and the humidification to the aforementioned gas is stopped first. Consequently, the single electrode potential of anode 62a falls, and this state will be made to continue, if the single electrode potential of cathode 62b rises and output voltage is recovered.
[0039] However, when the single electrode potential of the aforementioned anode 62a and cathode 62b is not recovered, the amount of humidification to hydrogen gas and oxygen gas is increased by judging with dryness of the solid-state polyelectrolyte film 60 being the cause, outputting a control signal to Humidifiers 84a and 84b, and raising the temperature of the humidifiers 84a

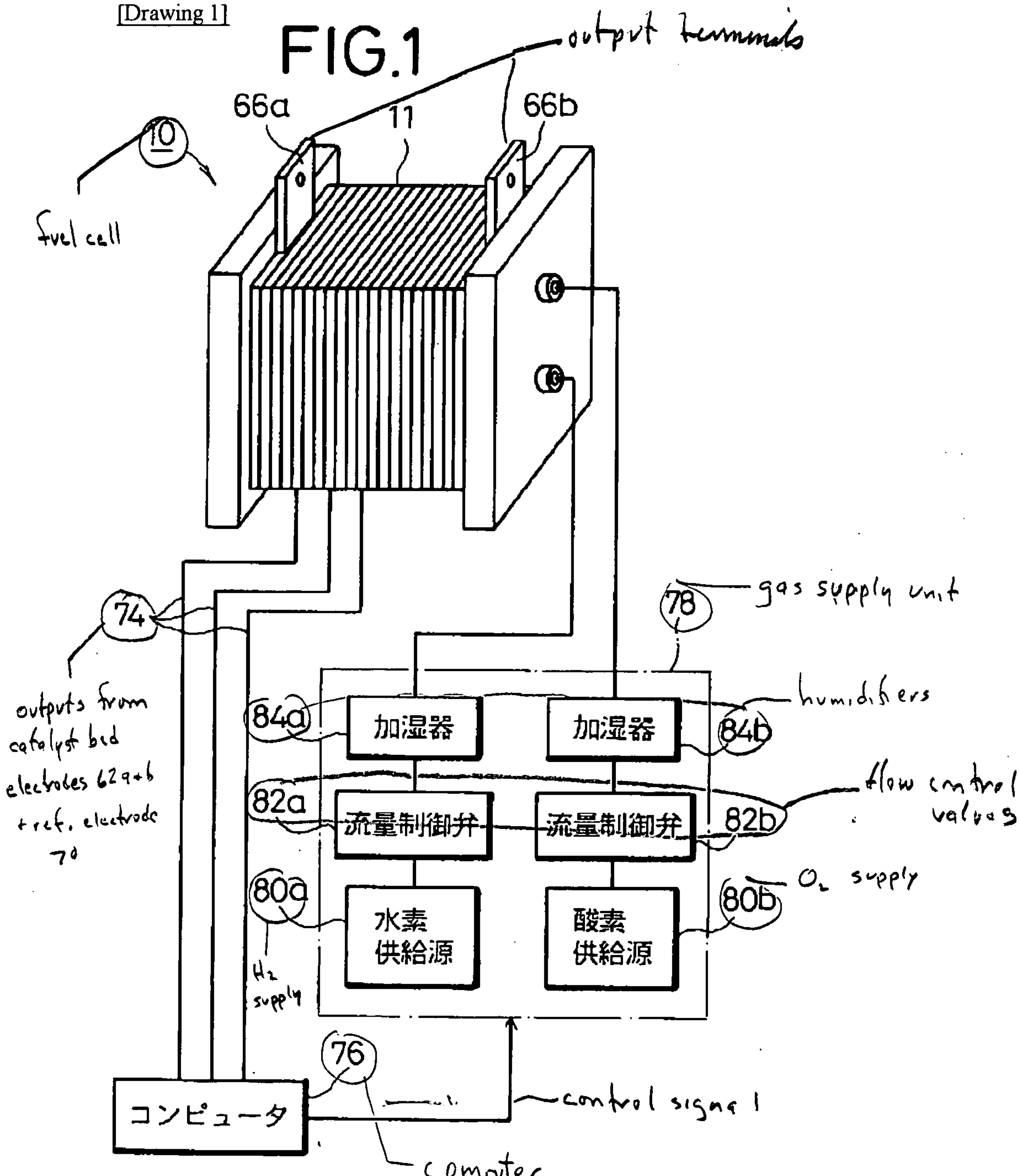
and 84b concerned. Consequently, moisture is fully supplied to the solid-state polyelectrolyte film 60, and ion conductivity is recovered. Therefore, the single electrode potential of anode 62a falls, the single electrode potential of cathode 62b rises, and the output voltage of the unit cell 11 is recovered.
[0040] Thus, in the fuel cell 10 concerning this example, since the reference electrode 70 was formed in pore 30 and it outputted to the computer 76 with the output signal of anode 62a and cathode 62b, the single electrode potential of anode 62a and cathode 62b was called for by computer 76. Based on change of this single electrode potential, causes, such as stay of generation water to aforementioned anode 62a or cathode 62b and dryness of the solid-state polyelectrolyte film 60, are judged, based on the aforementioned judgment, the flow rate of hydrogen gas and oxygen gas can be controlled, or the output voltage of a unit cell can be maintained to a steady state by controlling the amount of humidification to the aforementioned gas.
[0041] Moreover, since the reference electrode 70 was formed in the pore 30 which is open for free passage from a breakthrough 26 to a charge collector 50, composition of hydrogen gas cannot change to it and a reference potential can be stably detected to it.
[0042] In addition, although a reference electrode is prepared in one or more unit cells, the single electrode potential of anode 62a and cathode 62b is detected and the quantity of gas flow to all the unit cells 11 and the amount of humidification to the gas concerned are identically controlled by this example based on the aforementioned detection value, it is still more suitable if the flow control valve and humidifier of gas which are supplied to each unit cell are formed while preparing a reference electrode in all unit cells. Namely, based on the single electrode potential of each unit cell, the flow rate of the gas to each unit cell and the amount of humidification to gas can be controlled by each unit cell, and minute control is attained for every unit cell by it.

[Translation done.]

DRAWINGS

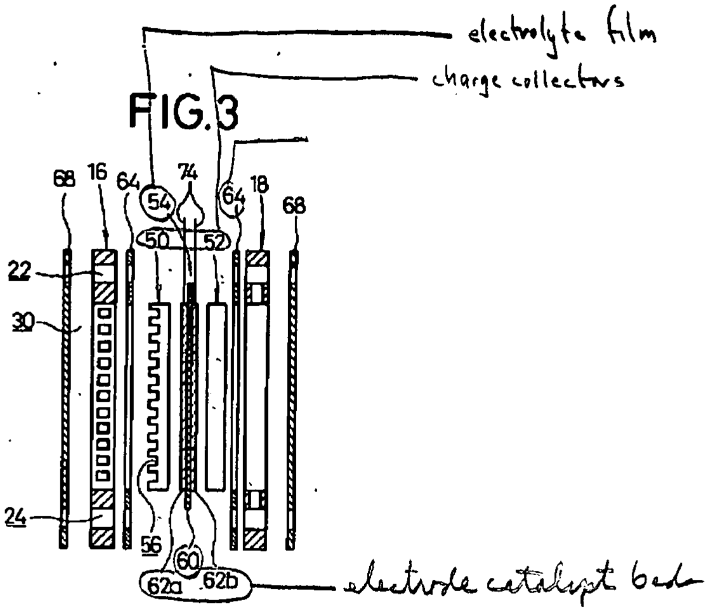
[Drawing 1]

FIG.1



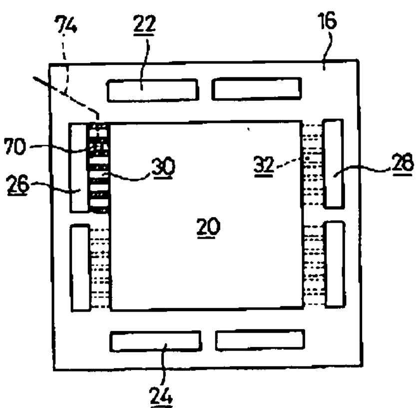
[Drawing 3]

FIG.3



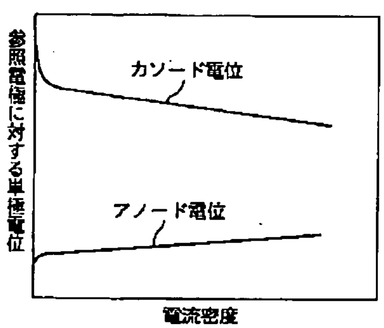
[Drawing 4]

FIG.4



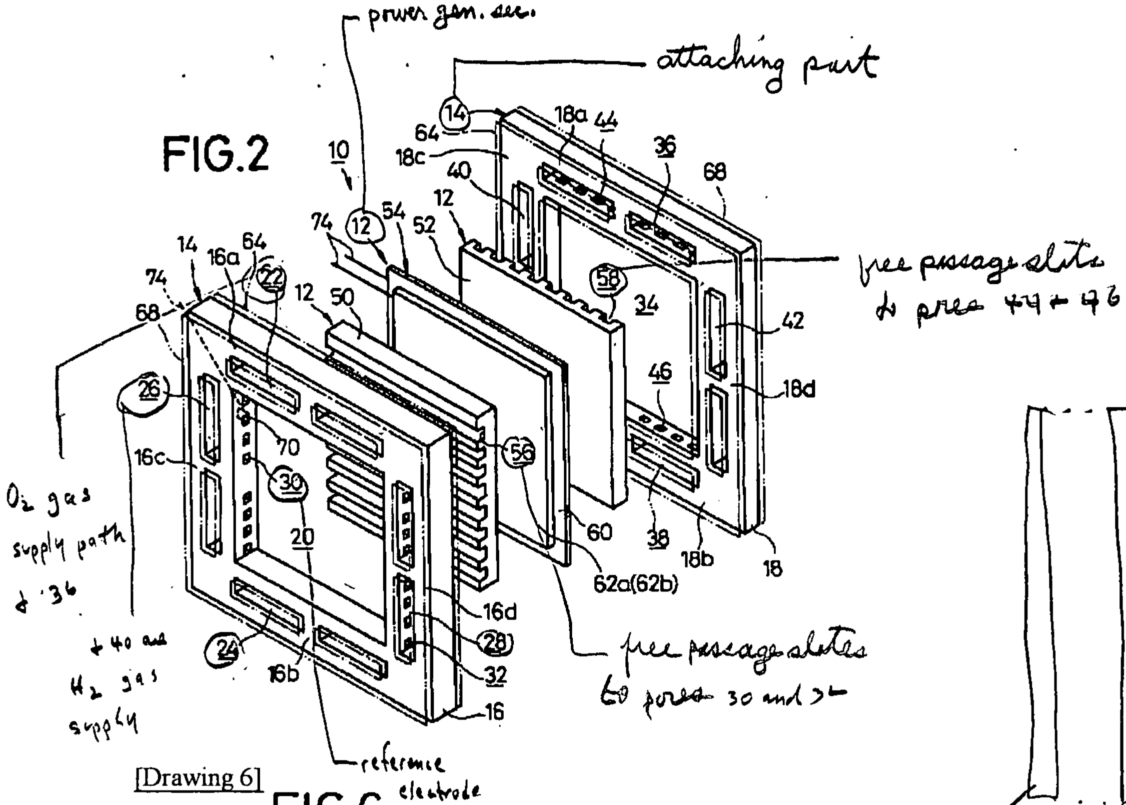
[Drawing 5]

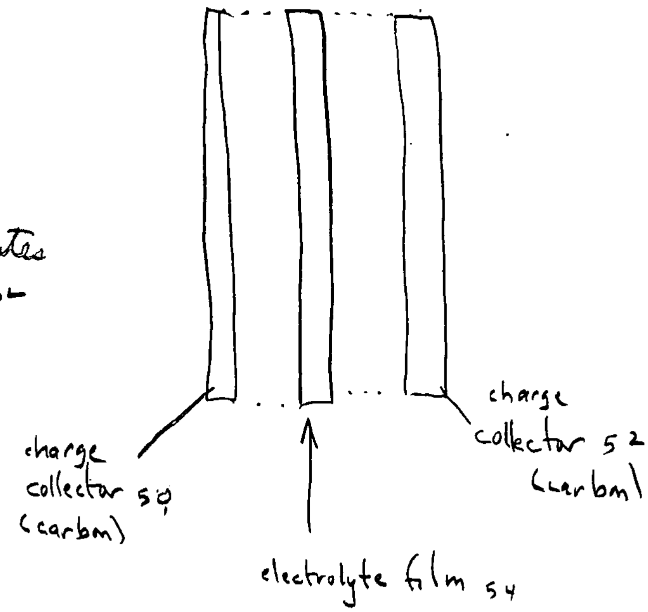
FIG.5



[Drawing 2]

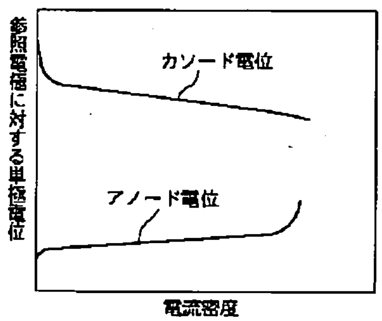
FIG.2





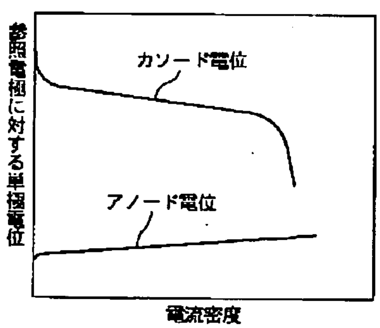
[Drawing 6]

FIG.6



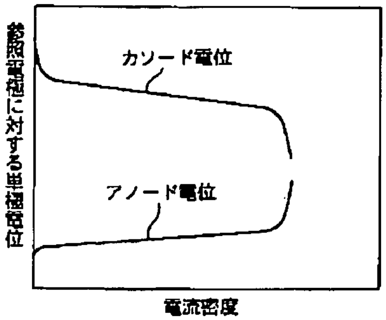
[Drawing 7]

FIG.7



[Drawing 8]

FIG.8



[Translation done.]

CORRECTION or AMENDMENT

[Official Gazette Type] Printing of amendment by the convention of 2 of Article 17 of patent law.
[Section partition] The 1st partition of the 7th section.
[Date of issue] July 6, Heisei 13 (2001. 7.6)

[Publication No.] JP,7-22047,A.
[Date of Publication] January 24, Heisei 7 (1995. 1.24)
[**** format] Open patent official report 7-221.
[Filing Number] Japanese Patent Application No. 5-159044.
[The 7th edition of International Patent Classification]

H01M 8/04

[FI]

H01M 8/04 K

[Procedure revision]
[Filing Date] June 28, Heisei 12 (2000. 6.28)
[Procedure amendment 1]
[Document to be Amended] Specification.
[Item(s) to be Amended] Claim.
[Method of Amendment] Change.
[Proposed Amendment]
[Claim(s)]
[Claim 1] It is the control method of a solid-state macromolecule type fuel cell of supplying hydrogen content gas and oxygen content gas, respectively, and detecting the single electrode potential of an anode and a cathode to the anode and cathode which are joined to the both sides of an electrolyte film using a reference electrode.
The aforementioned anode and process in which the single electrode potential of the aforementioned cathode is detected,
Process in which the situation inside a fuel cell is judged based on the aforementioned single electrode potential,
Process in which the flow rate of the hydrogen content gas supplied to an anode and a cathode based on the aforementioned judgment and oxygen content gas and the amount of humidification to the aforementioned hydrogen content gas and the aforementioned oxygen content gas are adjusted,
The control method of the solid-state macromolecule type fuel cell characterized by ****(ing).
[Claim 2] It is the control method of a solid-state macromolecule type fuel cell of supplying hydrogen content gas and oxygen content gas, respectively, and detecting the single electrode potential of an anode and a cathode to the anode and cathode which are joined to the both sides of an electrolyte film using a reference electrode.
The aforementioned anode and process in which the single electrode potential of the aforementioned cathode is detected,
Process in which the situation inside a fuel cell is judged based on the aforementioned single electrode potential,
Process in which the flow rate of the hydrogen content gas supplied to an anode based on the aforementioned judgment and the amount of humidification to the aforementioned hydrogen content gas are adjusted,
The control method of the solid-state macromolecule type fuel cell characterized by ****(ing).
[Claim 3] It is the control method of a solid-state macromolecule type fuel cell of supplying hydrogen content gas and oxygen content gas, respectively, and detecting the single electrode potential of an anode and a cathode to the anode and cathode which are joined to the both sides of an electrolyte film using a reference electrode.
The aforementioned anode and process in which the single electrode potential of the aforementioned cathode is detected,
Process in which the situation inside a fuel cell is judged based on the aforementioned single electrode potential,
Process in which the flow rate of the oxygen content gas supplied to a cathode based on the aforementioned judgment and the amount of humidification to the aforementioned oxygen content gas are adjusted,

The control method of the solid-state macromolecule type fuel cell characterized by ****(ing).
[Claim 4] Process in which the situation inside the aforementioned fuel cell is judged in the control method given in a claim 1 or any 1 term of 3 is a process judged as generation water piling up only in the aforementioned anode.
Process judged as generation water piling up only in the aforementioned cathode,
Process judged as generation water piling up in the both sides of the aforementioned anode and the aforementioned cathode,
Process judged as the moisture of the aforementioned electrolyte film decreasing,
** -- the control method of the solid-state macromolecule type fuel cell characterized by including either even if few
[Claim 5] When the unit potential of the aforementioned anode rises to the unit potential of the aforementioned cathode, while judging with generation water piling up in the aforementioned anode in the control method according to claim 4
The control method of a solid-state macromolecule type fuel cell that generation water is characterized by judging with piling up in the aforementioned cathode when the unit potential of the aforementioned cathode falls to the unit potential of the aforementioned anode.
[Claim 6] The control method of the solid-state macromolecule type fuel cell characterized by stopping the humidification to the aforementioned hydrogen content gas or the aforementioned oxygen content gas while making the flow rate of the aforementioned hydrogen content gas or the aforementioned oxygen content gas increase, when it judges with the aforementioned generation water piling up in the aforementioned anode or the aforementioned cathode in the control method according to claim 4 or 5.
[Claim 7] Process in which the humidification to the aforementioned hydrogen content gas and the aforementioned oxygen content gas is stopped while making the flow rate of the aforementioned hydrogen content gas and the aforementioned oxygen content gas increase, when the unit potential of the aforementioned anode rises to the unit potential of the aforementioned cathode and the unit potential of the aforementioned cathode falls to the unit potential of the aforementioned anode in the control method according to claim 4 or 5,
Process in which judge with the moisture of the aforementioned electrolyte film decreasing, and the amount of humidification to the aforementioned hydrogen content gas and the aforementioned oxygen content gas is increased in case the unit potential of the aforementioned anode and the unit potential of the aforementioned cathode are not recovered by the above-mentioned process,
The control method of the solid-state macromolecule type fuel cell characterized by ****(ing).
[Claim 8] In the fuel cell which supplies hydrogen content gas and oxygen content gas to an electrode from a hydrogen content gas supply path and an oxygen content gas supply path
The anode and cathode which are joined to electrolytic both sides,
The 1st reaction member which is open for free passage to the aforementioned hydrogen content gas supply path, and supplies hydrogen content gas to an anode,
The 2nd reaction member which is open for free passage to the aforementioned oxygen content gas supply path, and supplies oxygen content gas to a cathode,
The reference electrode which is a free passage portion by the side of the anode to the 1st reaction member of the aforementioned hydrogen content gas supply path, and is prepared corresponding to the aforementioned electrolyte,
The fuel cell characterized by ************.
[Procedure amendment 2]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0011.
[Method of Amendment] Change.
[Proposed Amendment]
[0011]
[Means for Solving the Problem] In order to attain the aforementioned purpose, it is characterized by equipping this invention with the following. Process in which are the control method of a solid-state macromolecule type fuel cell of supplying hydrogen content gas and oxygen content gas, respectively, and detecting the single electrode potential of an anode and a cathode to the anode and cathode which are joined to the both sides of an electrolyte film using a reference electrode, and the single electrode potential of the aforementioned anode and the aforementioned cathode is detected. Process in which the situation inside a fuel cell is judged based on the aforementioned single electrode potential. Process in which the flow rate of the hydrogen content gas supplied to an anode and a cathode based on the aforementioned judgment and oxygen content gas and the amount of humidification to the aforementioned hydrogen content gas and oxygen content gas are adjusted. Furthermore, it is characterized by equipping this invention with the following. Process in which are the control method of a solid-state macromolecule type fuel cell of supplying hydrogen content gas and oxygen content gas, respectively, and detecting the single electrode potential of an anode and a cathode to the anode and cathode which are joined to the both sides of an electrolyte film using a reference electrode, and the single electrode potential of the aforementioned anode and the aforementioned cathode is detected. Process in which the situation inside a fuel cell is judged based on the aforementioned single electrode potential. Process in which the flow rate of the hydrogen content gas supplied to an anode based on the aforementioned judgment and the amount of humidification to the aforementioned hydrogen content gas are adjusted. It is characterized by equipping this invention with the following further again. Process in which are the control method of a solid-state macromolecule type fuel cell of supplying hydrogen content gas and oxygen content gas, respectively, and detecting the single electrode potential of an anode and a cathode to the anode and cathode which are joined to the both sides of an electrolyte film using a reference electrode, and the single electrode potential of the aforementioned anode and the aforementioned cathode is detected. Process in which the situation inside a fuel cell is judged based

on the aforementioned single electrode potential. Process in which the flow rate of the oxygen content gas supplied to a cathode based on the aforementioned judgment and the amount of humidification to the aforementioned oxygen content gas are adjusted.
[Procedure amendment 3]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0012.
[Method of Amendment] Change.
[Proposed Amendment]
[0012] Moreover, this invention is characterized by equipping with the following the fuel cell which supplies hydrogen content gas and oxygen content gas to an electrode from a hydrogen content gas supply path and an oxygen content gas supply path. The anode and cathode which are joined to electrolytic both sides. the 1st reaction which is open for free passage to the aforementioned hydrogen content gas supply path, and supplies hydrogen content gas to an anode -- a member The reference electrode which is a free passage portion by the side of the anode to the 2nd reaction member which is open for free passage to the aforementioned oxygen content gas supply path, and supplies oxygen content gas to a cathode, and the 1st reaction member of the aforementioned hydrogen content gas supply path, and is prepared corresponding to the aforementioned electrolyte.
[Procedure amendment 4]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0013.
[Method of Amendment] Change.
[Proposed Amendment]
[0013]
[Function] By the control method of the solid-state macromolecule type fuel cell concerning this invention, the single electrode potential of an anode and a cathode is detected using a reference electrode, respectively, the situation inside a fuel cell is judged based on change of the aforementioned single electrode potential, and the amount of humidification to the flow rate of the hydrogen content gas supplied to an anode and a cathode and/or oxygen content gas and the aforementioned hydrogen content gas, and/or the aforementioned oxygen content gas is adjusted. For example, if the single electrode potential of the anode of a fuel cell is rising when increasing the load of a fuel cell, or if the single electrode potential of a cathode is falling, it judges with generation water overflowing with the electrodes concerned, and while making the flow rate of the hydrogen content gas supplied to the electrode concerned, or oxygen content gas increase, the humidification to the aforementioned hydrogen content gas or the aforementioned oxygen content gas will be stopped. On the other hand, if the single electrode potential of an anode rises and the single electrode potential of a cathode is falling, it will judge with generation water being full of two electrodes first, the humidification to hydrogen content gas and oxygen content gas will be stopped, and the flow rate of the aforementioned hydrogen content gas and the aforementioned oxygen content gas will be made to increase. If a situation still does not improve, it judges with the electrolyte film being dry, and the amount of humidification to the aforementioned hydrogen content gas and the aforementioned oxygen content gas is made to increase.
[Procedure amendment 5]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0014.
[Method of Amendment] Change.
[Proposed Amendment]
[0014] Moreover, by the fuel cell concerning this invention, since it is a free passage portion by the side of the anode to the 1st reaction member of a hydrogen content gas supply path and the reference electrode was prepared corresponding to the aforementioned electrolyte, the concentration of the hydrogen content gas which acts on a reference electrode becomes almost fixed, and the reference potential by which the reference electrode was stabilized is shown. Therefore, an anode and a cathode, and each single electrode potential are detectable with a sufficient precision.
[Procedure amendment 6]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0018.
[Method of Amendment] Change.
[Proposed Amendment]
[0018] The aforementioned attaching part 14 comes to carry out the laminating of the 1st comparatively thick board (the 1st reaction member) 16 and the 2nd board (the 2nd reaction member) 18. The rectangular parallelepiped-like breakthroughs 22, 24, 26, and 28 are formed by cope-box 16a of the 1st board 16 of the above, drag-flask 16b, and side frames 16c and 16d, respectively so that the osculum 20 of a **** square configuration may be formed by the center section of the 1st board 16 and this osculum 20 may be surrounded in it. In this case, a breakthrough 26 is open for free passage through an osculum 20 and two or more pores 30, and, on the other hand, the breakthrough 28 is opening it for free passage with the osculum 20 through two or more pores 32 similarly.
[Procedure amendment 7]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0031.
[Method of Amendment] Change.

[Proposed Amendment]
[0031] First, oxygen content gas supplied based on the control signal from a computer 76 from hydrogen source-of-supply 80a and oxygen-supply 80b, respectively. The flow rate of (it is only hereafter called oxygen gas) and hydrogen content gas (only henceforth hydrogen gas) is controlled by flow control valves 82a and 82b to the specified quantity, and the steam of the specified quantity is further added and humidified to the aforementioned oxygen gas and hydrogen gas by controlling Humidifiers 84a and 84b to predetermined temperature.
[Procedure amendment 8]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0044.
[Method of Amendment] Change.
[Proposed Amendment]
[0044] That is, by the control method of the solid-state macromolecule type fuel cell concerning this invention, the single electrode potential of an anode and a cathode is detected using a reference electrode, respectively, the situation inside a fuel cell is judged based on change of the aforementioned single electrode potential, and the amount of humidification to the flow rate of the hydrogen content gas supplied to an anode and a cathode and/or oxygen content gas and the aforementioned hydrogen content gas, and/or the aforementioned oxygen content gas is adjusted. For example, if the single electrode potential of an anode is rising when increasing the load of a fuel cell, or if the single electrode potential of a cathode is falling, it judges with generation water overflowing with the electrodes concerned, and while making the flow rate of the hydrogen content gas supplied to the electrode concerned, or oxygen content gas increase, the humidification to the aforementioned hydrogen content gas or the aforementioned oxygen content gas will be stopped. On the other hand, if the single electrode potential of an anode rises and the single electrode potential of a cathode is falling, it will judge with generation water being full of two electrodes first, the humidification to hydrogen content gas and oxygen content gas will be stopped, and a flow rate will be made to increase. If a situation still does not improve, it judges with the electrolyte film being dry, and the amount of humidification to the aforementioned hydrogen content gas and the aforementioned oxygen content gas is made to increase. Thus, the situation inside a unit cell can be judged based on the single electrode potential of a unit cell, and the amount of humidification to the flow rate of hydrogen content gas and oxygen content gas, hydrogen content gas, and oxygen content gas can be adjusted quickly.
[Procedure amendment 9]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0045.
[Method of Amendment] Change.
[Proposed Amendment]
[0045] Moreover, by the fuel cell concerning this invention, since it is a free passage portion by the side of the anode to the 1st reaction member of a hydrogen content gas supply path and the reference electrode was prepared corresponding to the aforementioned electrolyte, the concentration of the hydrogen content gas which acts on a reference electrode becomes almost fixed, and the reference potential by which the reference electrode was stabilized is shown. Therefore, an anode and a cathode, and each single electrode potential are detectable with a sufficient precision.

[Translation done.]

DERWENT-ACC-NO: 1995-095117

DERWENT-WEEK: 199513

TITLE: Solid polymeric electrolyte fuel cell battery control - compares cell individual electrode potentials with reference electrode and regulates humidification, fuel and air flow rates

PATENT-ASSIGNEE: HONDA MOTOR CO LTD[HOND]

PRIORITY-DATA: 1993JP-0159044 (June 29, 1993)

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 07022047 A	January 24, 1995	N/A	007	H01M 008/04

APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
JP 07022047A	N/A	1993JP-0159044	June 29, 1993

INT-CL (IPC): H01M008/04

ABSTRACTED-PUB-NO: JP 07022047A

BASIC-ABSTRACT:

The solid polymeric electrolyte fuel cell battery (10) comprises a set of unit cells (11) connected appropriately. Operational cell voltage which is the difference between anode and cathode electrode potentials is accessed by use of reference electrode that enables measurement of individual electrode potentials.

A computer (76) receives these measurements through lead
wires (74) and
actuates gas supply units (78) by way of corrective action.
This in turn
comprises a set of flow control valves (82a,82b) and
humidifiers (84a,84b) that
regulate fuel and air flow rates and their humidity levels
thus restoring
voltage deviations.

ADVANTAGE - Helps to obtain precise control of operational
voltage under
varying load conditions.

CHOSEN-DRAWING: Dwg.1/8

TITLE-TERMS: SOLID POLYMERISE ELECTROLYTIC FUEL CELL
BATTERY CONTROL COMPARE
CELL INDIVIDUAL ELECTRODE POTENTIAL REFERENCE
ELECTRODE REGULATE
HUMIDIFY FUEL AIR FLOW RATE

DERWENT-CLASS: X16

EPI-CODES: X16-C01; X16-C09;

SECONDARY-ACC-NO:
Non-CPI Secondary Accession Numbers: N1995-074915

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（A）　(11)特許出願公開番号

特開平7－22047

(43)公開日　平成7年(1995)1月24日

(51)Int.Cl.6	識別記号	庁内整理番号	F I	技術表示箇所
H01M　8/04	K			

審査請求　未請求　請求項の数2　OL　（全 7 頁）

(21)出願番号　特願平5－159044

(22)出願日　平成5年(1993)6月29日

(71)出願人　000005326
本田技研工業株式会社
東京都港区南青山二丁目1番1号

(72)発明者　馬場　一郎
埼玉県和光市中央1－4－1　株式会社本田技術研究所内

(72)発明者　岡本　隆文
埼玉県和光市中央1－4－1　株式会社本田技術研究所内

(72)発明者　田中　学
埼玉県和光市中央1－4－1　株式会社本田技術研究所内

(74)代理人　弁理士　千葉　剛宏　(外1名)

最終頁に続く

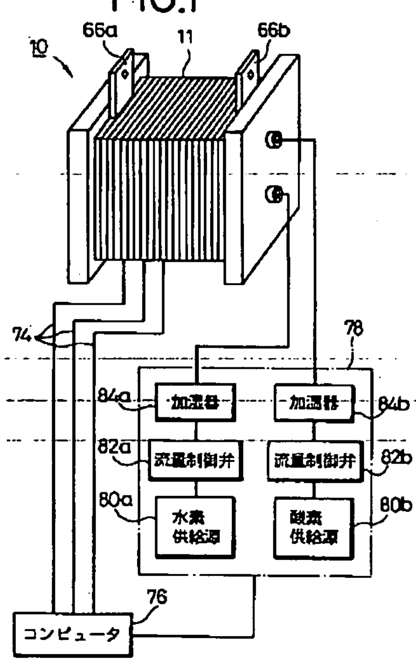
(54)【発明の名称】　固体高分子型燃料電池の制御方法および燃料電池

(57)【要約】

【目的】簡単な構成で、燃料電池中の固体高分子電解質膜および電極の状態を適切な状態に維持する固体高分子型燃料電池の制御方法および燃料電池を提供することを目的とする。

【構成】単位電池１１が積層された燃料電池１０において、単位電池１１に参照電極を設け、当該単位電池１１のアノードとカソードの単極電位をコンピュータ７６で算出する。前記単極電位の変化に基づき、単位電池１１の出力低下の原因を推定する。前記推定に基づき、流量制御弁８２ａ、８２ｂあるいは加湿器８４ａ、８４ｂに制御信号を出力することにより、水素ガスあるいは酸素ガスの流量、あるいは前記ガスに対する加湿量を調節する。したがって、単位電池１１の出力が素早く回復する。

FIG.1



1

【特許請求の範囲】
【請求項１】電解質膜の両側に接合されているアノードおよびカソードに対して、それぞれ第１反応体および第２反応体を供給し、参照電極を用いてアノードとカソードの単極電位を検出する固体高分子型燃料電池の制御方法であって、
前記アノードと前記カソードの単極電位を検出する過程と、
前記単極電位に基づいて、燃料電池内部の状況を判定する過程と、
前記判定に基づいてアノードおよびカソードに供給する第１反応体および第２反応体の流量および前記反応体に対する加湿量を調節する過程と、
を有することを特徴とする固体高分子型燃料電池の制御方法。
【請求項２】反応体供給通路から電極に反応体を供給する燃料電池において、
電解質の両側に接合されているアノードおよびカソードと、
前記反応体供給通路に連通し、第１反応体をアノードに供給する第１反応部材と、
前記反応体供給通路に連通し、第２反応体をカソードに供給する第２反応部材と、
前記反応体供給通路の第１反応部材に対する連通部分とアノードとの間に設けられる参照電極と、
を備えることを特徴とする燃料電池。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、固体高分子型燃料電池の制御方法および燃料電池に関し、一層詳細には、固体高分子型燃料電池における湿度と温度を好適に制御するための方法および単位電池の単極電位を検出できる機構を備えた燃料電池に関する。
【０００２】
【従来の技術】固体高分子型燃料電池は、固体高分子電解質膜の両側に電極触媒を接合して構成されている。前記電極触媒に燃料ガスと反応ガス、例えば、酸素と水素を供給し、前記電解質膜中を水素イオンが移動することにより、前記燃料電池で発電作用を営ませる。
【０００３】ところで、例えば、負荷の急激な増加時には、前記ガスの供給量を増加させることになるが、このガス流により前記電解質膜の水分が蒸発するため、また、反応に伴う発熱量の増加により電解質膜が乾燥してイオン導電度を低下させるおそれがある。この結果、所望の出力電圧を取り出すことが困難となる。
【０００４】そこで、この対策として、特開平３－１０２７７４号公報には、前記電極にガスを供給するガスセパレータにガス供給溝の他に冷却水を流す水供給溝を設ける技術的思想が開示されている。したがって、この公報の技術的思想では、通常時には、ガスに水蒸気を添加

2

して前記電解質膜に対する水分の補給を行うが、高負荷運転時には、前記水供給溝から、冷却水を供給することにより電解質膜を冷却するとともに、水分を補給して当該電解質膜を適度な湿度に維持する。さらに、前記供給溝に連通する導入管に供給水の温度調節器および流量調節弁を設け、温度センサを電極もしくは固体高分子電解質膜の近傍に配置し、また、水分センサを固体高分子電解質膜の近傍に配置し、両センサの出力信号により温度調節器および流量調節弁を制御することにより、自動的に制御することができるとしている。また、燃料電池から離間させて冷却用の部材を設けることにより、燃料電池を冷却する技術的思想も提案されている（特開平２－２６０３７１号公報）。
【０００５】一方、ガスの反応によって電極で生成された水分が凝縮した場合には、前記ガスが電極に均一に分布されないために、発電力が損なわれる。
【０００６】この対策として、例えば、米国特許第４，１７５，１６５号公報には、燃料電池中の適切な位置に親水性塗膜を塗布して生成水の流出を助長する方法が開示されている。
【０００７】
【発明が解決しようとする課題】しかしながら、前記の特開平３－１０２７７４号公報の如く前記ガスセパレータに水供給溝を設ける場合には、ガスセパレータの構造が複雑になるとともに、この水の供給用通路も増やす必要がある等の問題がある。また、冷却用の部材を燃料電池から離間させて設ける場合には、構成が大型化してしまう。
【０００８】さらに、前記米国特許第４，１７５，１６５号公報に開示されるように燃料電池中の適切な場所に親水性塗膜を塗布して、生成水の流出を行うだけでは、固体高分子電解質膜の状態を適切な状態に制御できない。
【０００９】また、温度センサ、水分センサをつけて自動制御を行う場合でも、生成水がどこで過剰になっているかを検出するためには、少なくとも１つの単位電池を構成する２つの電極触媒に、それぞれ水分センサを設けなければならない。
【００１０】本発明は、この種の問題を解決するためになされたものであって、簡単な構成で、燃料電池中の固体高分子電解質膜および電極の状態を適切な状態に維持することが可能な固体高分子型燃料電池の制御方法および燃料電池を提供することを目的とする。
【００１１】
【課題を解決するための手段】前記の目的を達成するために、本発明は、電解質膜の両側に接合されているアノードおよびカソードに対して、それぞれ第１反応体および第２反応体を供給し、参照電極を用いてアノードとカソードの単極電位を検出する固体高分子型燃料電池の制御方法であって、前記アノードと前記カソードの単極電

位を検出する過程と、前記単極電位に基づいて、燃料電池内部の状況を判定する過程と、前記判定に基づいてアノードおよびカソードに供給する第１反応体および第２反応体の流量および前記反応体に対する加湿量を調節する過程と、を有することを特徴とする。

【００１２】また、本発明は、反応体供給通路から電極に反応体を供給する燃料電池において、電解質の両側に接合されているアノードおよびカソードと、前記反応体供給通路に連通し、第１反応体をアノードに供給する第１反応部材と、前記反応体供給通路に連通し、第２反応体をカソードに供給する第２反応部材と、前記反応体供給通路の第１反応部材に対する連通部分とアノードとの間に設けられる参照電極と、を備えることを特徴とする。

【００１３】

【作用】本発明に係る固体高分子型燃料電池の制御方法では、参照電極を用いてアノードとカソードの単極電位をそれぞれ検出し、前記単極電位の変動に基づいて燃料電池内部の状況を判定し、アノードおよびカソードに供給する第１反応体および第２反応体の流量および前記反応体に対する加湿量を調節している。例えば、燃料電池の負荷を増大させた場合、燃料電池のアノードの単極電位が上昇していれば、あるいはカソードの単極電位が低下していれば、当該電極で生成水が溢れていると判定し、当該電極に供給する反応体の流量を増加させるとともに、前記反応体への加湿を停止させる。これに対して、アノードの単極電位が上昇し、カソードの単極電位が低下していれば、先ず、両電極に生成水が溢れていると判定して、第１および第２反応体に対する加湿を停止させ、前記第１および第２反応体の流量を増加させる。それでも状況が改善しなければ、電解質膜が乾燥していると判定して、前記第１および第２反応体への加湿量を増加させる。

【００１４】また、本発明に係る燃料電池では、参照電極を反応体供給通路の第１反応部材に対する連通部分とアノードとの間に設けたため、参照電極に作用する第１反応体の濃度がほぼ一定となり、参照電極が安定した基準電位を示す。したがって、アノードおよびカソード、それぞれの単極電位を精度良く検出できる。

【００１５】

【実施例】本発明に係る固体高分子型燃料電池の制御方法および燃料電池について、好適な実施例を挙げ、添付の図面を参照しながら以下詳細に説明する。

【００１６】先ず、固体高分子型燃料電池について構成を説明し、次にその燃料電池の制御方法について説明する。

【００１７】燃料電池１０は、図１に示すように、単位電池１１を複数積層することによって構成されている。前記単位電池１１は、図２および図３に示すように、発電部１２と保持部１４とから構成される。

【００１８】前記保持部１４は、比較的厚みのある第１の板体１６と、第２の板体１８とを積層してなる。第１板体１６の中央部には、略正四角形状の大孔２０が画成され、この大孔２０を囲繞するように、前記第１板体１６の上枠１６ａ、下枠１６ｂ、側枠１６ｃ、１６ｄには、それぞれ直方体状の貫通孔２２、２４、２６、２８が画成されている。この場合、貫通孔２６は大孔２０と複数の細孔３０を介して連通し、一方、貫通孔２８は、同様に複数の細孔３２を介して大孔２０と連通している。

【００１９】次に、第２板体１８について説明する。第２板体１８の中央部には、第１板体１６と同様の大孔３４が画成され、その大孔３４を囲繞するように、上枠１８ａ、下枠１８ｂ、側枠１８ｃ、１８ｄには、それぞれ直方体状の貫通孔３６、３８、４０、４２が画成されている。この第2板体１８では、大孔３４と貫通孔３６とは複数の細孔４４によって連通されており、一方、該大孔３４と貫通孔３８とは、同様に、複数の細孔４６によって連通されている。

【００２０】次に、発電部１２について説明する。

【００２１】発電部１２は、基本的には、一組の集電体５０、５２と、前記集電体５０と５２との間で挟持される電極一体型電解質膜５４とから構成される。集電体５０と５２は、カーボンを素材とした剛体として形成される。

【００２２】前記集電体５０は保持部１４を構成する第１板体１６の大孔２０に若干の隙間をもって嵌合されるべく略正四角形状でかつ前記第１板体１６と略同じ厚さの板体からなる。

【００２３】前記集電体５０には、図2および図3に示すように、前記第１板体１６の細孔３０、３２と連通し且つ反応ガスを吸収するために表面積を拡大すべく複数の溝５６が形成される。従って、前記集電体５０が第１板体１６の大孔２０に嵌合されると、溝５６が細孔３０、３２を介してそれぞれ貫通孔２６、２８と連通する。

【００２４】集電体５２は、第２板体１８の大孔３４に対応する略正四角形状でかつこの第２板体１８と略同じ厚さの板体からなる。前記集電体５２には、該第２板体１８に画成されている細孔４４、４６に連通する複数の溝５８が画成されている。従って、前記集電体５２が第２板体１８の大孔３４に嵌合されると、溝５８が細孔４４、４６を介してそれぞれ貫通孔３６、３８と連通する。

【００２５】前記電極一体型電解質膜５４は、固体高分子電解質膜６０の両面に電極触媒層６２ａ、６２ｂを備えている。前記固体高分子電解質膜６０は、第１板体１６に関連して説明すると、その大きさが貫通孔２２、２４、２６、２８の内側端縁と略同じであり、一方、電極触媒層６２ａ、６２ｂの大きさは集電体５０、５２と略

同じである。

【0026】なお、前記第1板体16と第2板体18との間には、ガスケット64が介装されている。

【0027】このように構成された単位電池11を複数積層することにより、燃料電池10が構成されている。前記燃料電池10からの出力は、出力端子66a、66bから導出される（図1参照）。また、隣接する単位電池11との間には、前記第1板体16、第2板体18の貫通孔部分に対応する孔部が画成されたガスケット68が挟持されている。なお、単位電池11が積層された際、貫通孔22、36は酸素ガス供給通路として、貫通孔24、38は酸素ガス排出通路として、貫通孔26、40は水素ガス供給通路として、貫通孔28、42は水素ガス排出通路として用いられる。

【0028】前記燃料電池10の中、いくつかの単位電池11において、図4に示すように、第1板体16の細孔30にガス拡散電極からなる参照電極70が設けられ、電極触媒層62a、62bとともに、リード線74を介してコンピュータ76に信号が出力されている。

【0029】前記コンピュータ76は、図1に示すように、制御信号をガス供給ユニット78に供給する。前記ガス供給ユニット78は、それぞれ水素供給源80aと酸素供給源80bを備え、前記制御信号によって流量を制御する流量制御弁82a、82b、前記制御信号によって温度を変更して加湿量を変化させる加湿器84a、84bを備える。

【0030】次に、このように構成された燃料電池10の制御方法を以下、説明する。

【0031】先ず、コンピュータ76からの制御信号に基づき、それぞれ水素供給源80aと酸素供給源80bから供給される酸素ガスと水素ガスの流量を流量制御弁82a、82bによって所定量に制御し、さらに、加湿器84a、84bを所定の温度に制御することによって前記酸素ガスと水素ガスに所定量の水蒸気を加えて加湿する。

【0032】このように流量が所定量に規制され、所定量加湿された酸素ガスと水素ガスは、燃料電池10の内部に導入される。燃料電池10において、水素ガスは、各単位電池11の第1板体16の水素ガス供給通路である貫通孔26に達し、細孔30を介して集電体50の溝56に供給される。水素ガスは、前記集電体50から電極触媒層62aに達する。酸素ガスは、各単位電池11の第2板体18の酸素供給通路である貫通孔36に達し、細孔44から集電体52の溝58に供給される。前記酸素ガスは、前記集電体52から電極触媒層62bに達する。したがって、固体高分子電解質膜60中を水素イオンが移動し、各単位電池11の出力の総和が出力端子66a、66bから取り出される。

【0033】この際、参照電極70および電極触媒層62a、62bからの出力信号がリード線74を介してコンピュータ76に導入される。コンピュータ76では、前記参照電極70と電極触媒層62aの出力信号に基づき、水素ガスが供給される電極触媒層（以下、アノードという）62aの単極電位を検出する。同様に、前記参照電極70と電極触媒層62bの出力信号に基づき、酸素ガスが供給される電極触媒層（以下、カソードという）62bの単極電位を検出する。この際、参照電極70が細孔30に設けられているため、アノード62aに供給される水素ガスのみが前記参照電極70を通過し、通過するガスの組成が変化しないため、基準電位を安定的に出力している。したがって、アノード62aとカソード62bの単極電位を精度良く検出できる。

【0034】ここで、電流密度と前記アノード62aとカソード62bの単極電位との関係を図5～図8に示す。図5は正常な状態の電流密度と単極電位との関係を示す図である。なお、複数の単位電池11のアノード62aとカソード62bの単極電位を検出している場合には、アノード62aとカソード62b、それぞれ複数の単極電位値の平均値、最大値あるいは最小値の中、いずれかの値をコンピュータ76で求め、求めた値によって以下の制御を行う。

【0035】燃料電池10の負荷増大時には、図6に示すようなアノード62a、カソード62bの単極電位が検出されることがある。すなわち、アノード62aの単極電位のみが大幅に上昇して、単位電池11の出力電圧を低下させている。この場合、コンピュータ76では、アノード62aにおける物質の移動遅れが原因と判定する。すなわち、酸素ガスと水素ガスとの反応による生成水がアノード62aに滞留し、水素ガスの移動を阻むため、アノード62aの単極電位が大幅に上昇したと判定する。したがって、コンピュータ76から流量制御弁82aに水素ガス流量を増加させる信号が出力されるとともに、加湿器84aには、加湿を停止する信号が出力される。この結果、前記水素ガス流によってアノード62aの水分が蒸発されるとともに、前記水素ガスに対する加湿を停止するため、アノード62aに滞留している水分が除去される。したがって、アノード62aの単極電位が低下して所定の出力電圧に回復する。

【0036】同様に、図7に示すように、カソード62bの単極電位が大幅に低下した場合には、コンピュータ76がカソード62bにおける物質の移動遅れが原因と判定する。すなわち、生成水がカソード62bに滞留していると判定する。したがって、コンピュータ76から流量制御弁82bに酸素ガス量を増加させる制御信号が出力されるとともに、加湿器84bに酸素ガスに対する加湿を停止させる制御信号が出力される。これにより、カソード62bに単極電位が上昇して、単位電池11の出力電圧を回復する。

【0037】さらに、図8に示すように、アノード62aとカソード62b、双方の単極電位が大幅に低下した

場合には、上記のようにアノード６２ａとカソード６２ｂの双方に生成水が滞留した可能性も考えられるが、発電作用による発熱、あるいは水素または酸素のガス流によって固体高分子電解質膜６０の水分が減少し、イオン導電度が低下した可能性も考えられる。

【００３８】そこで、コンピュータ７６では、先ず、図６、図７の場合と同様に、水素ガス、酸素ガスの流量を増加させ、前記ガスに対する加湿を停止する。この結果、アノード６２ａの単極電位が低下し、カソード６２ｂの単極電位が上昇して出力電圧が回復すれば、この状態を継続させる。

【００３９】しかしながら、前記アノード６２ａとカソード６２ｂの単極電位が回復しない場合には、固体高分子電解質膜６０の乾燥が原因であると判定して、制御信号を加湿器８４ａ、８４ｂに出力して当該加湿器８４ａ、８４ｂの温度を上昇させることにより、水素ガス、酸素ガスに対する加湿量を増大させる。この結果、固体高分子電解質膜６０に充分に水分が供給され、イオン導電度が回復する。したがって、アノード６２ａの単極電位が低下し、カソード６２ｂの単極電位が上昇して単位電池１１の出力電圧が回復する。

【００４０】このように、本実施例に係る燃料電池１０では、参照電極７０を細孔３０に設け、アノード６２ａとカソード６２ｂの出力信号とともに、コンピュータ７６に出力したため、コンピュータ７６でアノード６２ａとカソード６２ｂの単極電位が求められた。この単極電位の変動に基づいて、前記アノード６２ａあるいはカソード６２ｂに対する生成水の滞留、固体高分子電解質膜６０の乾燥等の原因が判定され、前記判定に基づいて水素ガス、酸素ガスの流量を制御する、あるいは前記ガスに対する加湿量を制御することにより、単位電池の出力電圧を定常状態に維持することができる。

【００４１】また、貫通孔２６から集電体５０へ連通する細孔３０に、参照電極７０を設けたため、水素ガスの組成が変化することはなく、安定的に基準電位を検出することができる。

【００４２】なお、本実施例では、一つあるいは複数の単位電池に参照電極を設け、アノード６２ａおよびカソード６２ｂの単極電位を検出し、前記検出値に基づいて全ての単位電池１１に対するガス流量および当該ガスに対する加湿量を同一に制御しているが、全ての単位電池に参照電極を設けるとともに、各単位電池に供給されるガスの流量制御弁および加湿器を設ければ、さらに好適である。すなわち、各単位電池では、それぞれの単位電池の単極電位に基づいてそれぞれの単位電池に対するガスの流量およびガスに対する加湿量を制御することができ、各単位電池毎に精緻な制御が可能となる。

【００４３】

【発明の効果】本発明に係る固体高分子型燃料電池の制御方法および燃料電池によれば、以下の効果が得られる。

【００４４】すなわち、本発明に係る固体高分子型燃料電池の制御方法では、参照電極を用いてアノードとカソードの単極電位をそれぞれ検出し、前記単極電位の変動に基づいて燃料電池内部の状況を判定し、アノードおよびカソードに供給する第１反応体および第２反応体の流量および前記反応体に対する加湿量を調節している。例えば、燃料電池の負荷を増大させた場合、アノードの単極電位が上昇していれば、あるいはカソードの単極電位が低下していれば、当該電極で生成水が溢れていると判定し、当該電極に供給する反応体の流量を増加させるとともに、前記反応体への加湿を停止させる。これに対して、アノードの単極電位が上昇し、カソードの単極電位が低下していれば、先ず、両電極に生成水が溢れていると判定して第１および第２反応体に対する加湿を停止させ、流量を増加させる。それでも状況が改善しなければ、電解質膜が乾燥していると判定して、前記第１および第２反応体への加湿量を増加させる。このようにして、単位電池の単極電位に基づいて単位電池内部の状況を判定し、素早く反応体の流量および反応体に対する加湿量の調節を行うことができる。

【００４５】また、本発明に係る燃料電池では、参照電極を反応体供給通路の第１反応部材に対する連通部分とアノードとの間に設けたため、参照電極に作用する第１反応体の濃度がほぼ一定となり、参照電極が安定した基準電位を示す。したがって、アノードおよびカソード、それぞれの単極電位を精度良く検出できる。

【図面の簡単な説明】

【図１】本発明に係る固体高分子型燃料電池の概略構成説明図である。

【図２】本発明に係る固体高分子型燃料電池の要部分解斜視図である。

【図３】本発明に係る固体高分子型燃料電池の縦断面図である。

【図４】本発明に係る固体高分子型燃料電池の平面図である。

【図５】本発明に係る固体高分子型燃料電池の制御方法における電流密度と単極電位の相関関係を示す図である。

【図６】本発明に係る固体高分子型燃料電池の制御方法における電流密度と単極電位の相関関係を示す図である。

【図７】本発明に係る固体高分子型燃料電池の制御方法における電流密度と単極電位の相関関係を示す図である。

【図８】本発明に係る固体高分子型燃料電池の制御方法における電流密度と単極電位の相関関係を示す図である。

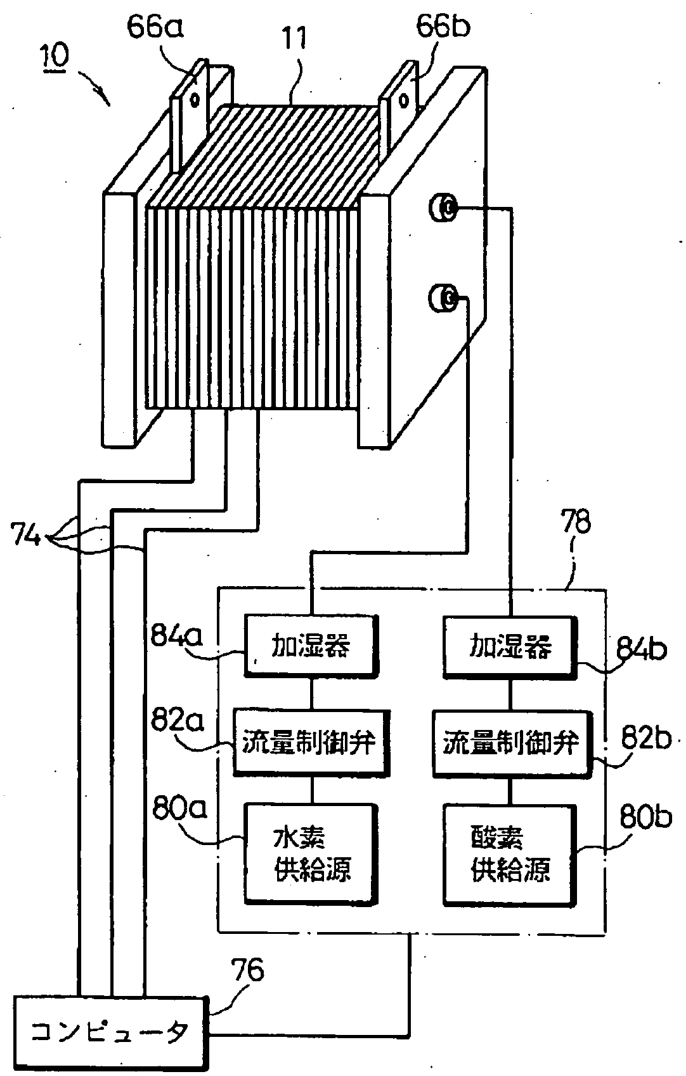
【符号の説明】

１０…燃料電池　　１１…単位電

池
１２…発電部　１４…保持部
６２ａ、６２ｂ…電極触媒層　７０…参照電極
７４…リード線　７６…コンピュータ
７８…ガス供給ユニット　８２ａ、８２ｂ…流量制御弁
８４ａ、８４ｂ…加湿器

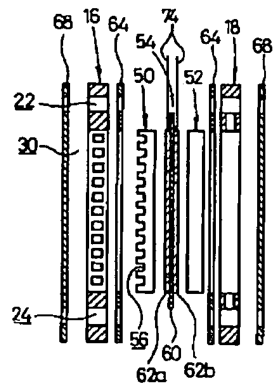
【図1】

FIG.1



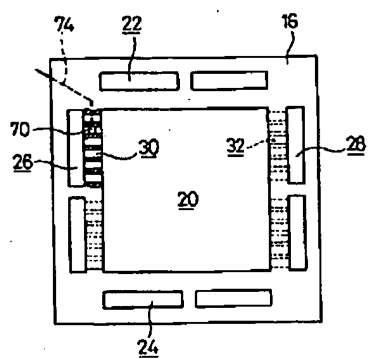
【図3】

FIG.3



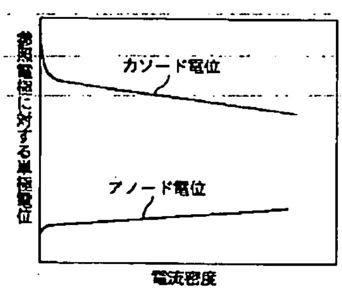
【図4】

FIG.4



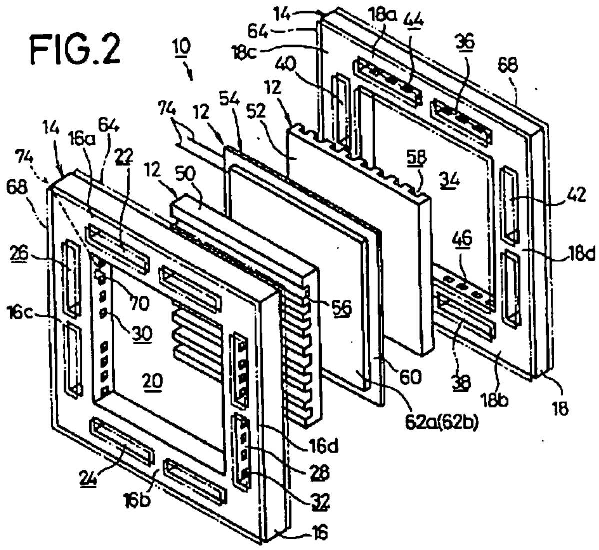
【図5】

FIG.5



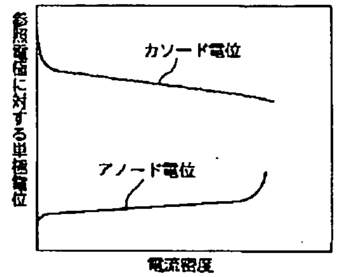
【図2】

FIG.2



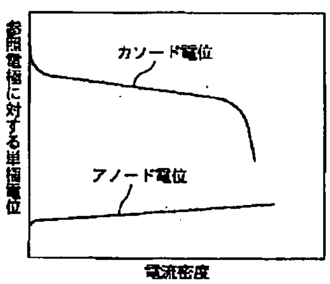
【図6】

FIG.6



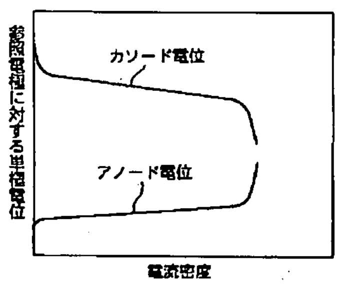
【図7】

FIG.7



【図8】

FIG.8



フロントページの続き

(72)発明者　加藤　英男
埼玉県和光市中央1－4－1　株式会社本田技術研究所内

(72)発明者　川越　敬正
埼玉県和光市中央1－4－1　株式会社本田技術研究所内